No prophylactic or therapeutic modality that is efficient and specific against infection by the viruses hRSV and hMPV exists today on the market, although active research is underway (Mazur et al., 2018).

For treatment, ribavirin, not exempt from undesirable effects, or intravenous immunoglobulins, very expensive, may be used occasionally in serious cases of infections by hMPV or hRSV. Other types of treatments are currently being developed such as the use of fusion inhibitor peptides, sulphated glycosaminoglycans, interfering RNAs and certain immunomodulators.

The usual and widely favoured clinical approach today consists in treating especially the symptoms of the infection, while placing patients under respiratory assistance (administration of oxygen or mechanical ventilation) and by administering to them bronchodilators, corticosteroids and/or antibiotics for preventing or treating bacterial superinfections.

Regarding the vaccination, the populations particularly affected by hMPV being infants, young children and the elderly, it is crucial to have rapidly safe and effective vaccines, in order to reduce severe respiratory attacks which have a dramatic impact in these age ranges.

The development of a vaccine against hRSV and hMPV thus represents not only a major health challenge, but also a real socio-economic issue with the objective of reducing the high cost of treatments and hospitalisations associated with these infections, and of decreasing the use of antibiotics in the context of bacterial superinfections, and thus limiting the emergence of resistances.

Summary

In one aspect, the present disclosure refers to an attenuated virus strain derived from a human metapneumovirus strain comprising the genome sequence represented by sequence SEQ ID NO. 1, said attenuated strain comprising one or more genetic modifications of said sequence SEQ ID NO. 1 attenuating the virulence of said strain. In another aspect, the present disclosure refers to an *in vitro* use of the attenuated virus strain as disclosed herein, as expression vector of at least one exogenous gene in target cells of human metapneumovirus. In another aspect, the present disclosure refers to the attenuated virus strain as disclosed herein, for use as a medicament. In another aspect, the present disclosure refers to a use of the attenuated virus strain as disclosed herein in the manufacture of a medicament for preventing and/or treating infections by viruses of the Pneumoviridae family. In another aspect, the present disclosure refers to a use of the attenuated virus strain as disclosed herein in the manufacture of a medicament for preventing and/or treating infections by viruses, wherein at least one viral antigen is expressed by said attenuated virus strain. In another aspect, the present disclosure refers to a vaccine composition comprising, in a pharmaceutically acceptable vehicle, at least one attenuated virus strain as disclosed herein, and optionally an adjuvant.

PRIOR ART

Tables 1, 2 and 3 below list the different approaches under development for obtaining living attenuated vaccines from wild hMPV strains.

Virus strains are considered as being attenuated *in vitro* when they exhibit decreased replicative capacity compared to the wild type (WT) virus, and/or when these virus strains lead to the more restricted formation of infectious outbreaks, notably of syncytia (adjacent cells fusing following viral infection). *In vivo,* attenuated virus strains replicate at a lower maximum load and/or induce less severe pathology (in terms of weight loss or inflammatory profile or histo-pathological damage) than the wild virus strain.

Table 1. List of living vaccine candidates attenuated on the basis of a strain of hMPV virus having one or more mutations, developed or under development

CLAIMS

1. Attenuated virus strain derived from a human metapneumovirus strain comprising the genome sequence represented by sequence SEQ ID NO. 1, said attenuated strain comprising one or more genetic modifications of said sequence SEQ ID NO. 1 attenuating the virulence of said strain.

2. Attenuated virus strain according to claim 1, characterised in that the modifications of sequence SEQ ID NO.1 comprise the inactivation of the gene encoding for the SH protein.

3. Attenuated virus strain according to claim 2, characterised in that said strain comprises sequence SEQ ID NO.2.

4. Attenuated virus strain according to claim 1, characterised in that the modifications of sequence SEQ ID NO.1 comprise the inactivation of the gene encoding for the G protein.

5. Attenuated virus strain according to claim 4, characterised in that said strain comprises sequence SEQ ID NO.3.

6. Attenuated virus strain according to claim 1, characterised in that the modifications of sequence SEQ ID NO.1 comprise the inactivation of the two genes encoding for the G protein and the SH protein.

7. Attenuated virus strain according to one of claims 1 to 6, of which the sequence comprises at least one exogenous gene, in particular a gene encoding for a viral antigen.

8. *In vitro* use of an attenuated virus strain according to claim 7, as expression vector of at least one exogenous gene in target cells of human metapneumovirus.

9. Attenuated virus strain according to one of claims 1 to 7, for use as a medicament.

10. Use of an attenuated virus strain according to one of claims 1 to 7 in the manufacture of a medicament for preventing and/or treating infections by viruses of the Pneumoviridae family.

11. The use according to claim 10, wherein the viruses of the Pneumoviridae family are human metapneumoviruses.

12. The use according to claim 10, wherein viruses of the Pneumoviridae family are orthopneumoviruses, such as the human syncytial respiratory virus.

13. Use of attenuated virus strain according to claim 7 in the manufacture of a medicament for preventing and/or treating infections by viruses, wherein at least one viral antigen is expressed by said attenuated virus strain.

14. Vaccine composition comprising, in a pharmaceutically acceptable vehicle, at least one attenuated virus strain according to one of claims 1 to 7, and optionally an adjuvant.

15. Vaccine composition according to claim 14, characterised in that it is in a pharmaceutical form intended for administration by inhalation.